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Re: Attorney Docket No. 1052.039

In re application of: Peter B. Kenington

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For: A Predistorter

DECLARATION UNDER 37 C.F.R. 1.132

Commissioner for Patents
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Sir:

1. I, George P. Vella-Coleiro, am a resident alien and a citizen of Malta residing at 54 New England Avenue, Unit 6, Summit, New Jersey 07901.

2. I received a D.Phil. degree in Physics from Oxford University in England in 1967.

3. I have worked in the field of RF (radio frequency) signal processing since 1990.

4. I have read the above-referenced patent application.

5. I have read Japanese patent application no. 56-85909 (referred to herein as "Nojima") and U.S. patent no. 3,772,617 (referred to herein as "Cielsielka").

6. Just because cross-modulation of an input signal on a pilot signal may be "inherent" in Nojima, that does not necessarily mean that Nojima's system detects the presence of distortion signals derived from such cross-modulation. In fact, there is no teaching or even suggestion in Nojima that the disclosed system detects cross-modulation distortion signals. In fact, cross-modulation distortion signals are not even discussed in Nojima.

7. Intermodulation and cross-modulation are well-known concepts in the relevant art. The non-linearity of an amplifier results in intermodulation distortion (IMD) corresponding to "output frequencies equal to the sums and differences of integer multiples of the input frequency components." For example, in an amplifier system having two pilot signals at frequencies f_{p1} and f_{p2}, frequencies $2f_{p1}$-f_{p2} and $2f_{p2}$-f_{p1} are third-order intermodulation distortion signal components. See, e.g., Nojima, page 3, lines 28-29 ("In the figure, frequencies f_{p1} and f_{p2} are pilot signals and frequencies $2f_{p1}$-f_{p2} and $2f_{p2}$-f_{p1} are third-order intermodulation distortion signal components.")

8. Cross-modulation is different from intermodulation. Cross-modulation occurs when two signals are applied to a non-linear element, and the input modulation of one signal results in modulation of the other signal in the output of the non-linear element. See, e.g., Jack Roan, "Cross Modulation in a Full Duplex Transceiver: Causes, Effects, and Simulation," p.3, Agilent Technologies, July 2007 (http://eesof.tm.agilent.com/pdf/rfic_seminar_2007_roan.pdf) ("Cross modulation distortion (XMD) is the transfer of modulation from one signal to another due to nonlinearities in a mutual processing block (such as an amplifier)").

9. For example, if a modulated input signal and an unmodulated (e.g., CW) pilot signal are applied to a non-linear amplifier, cross-modulation of the input signal on the pilot signal refers to distortion of the pilot signal resulting from the transfer of modulation from the input signal to the pilot signal due to the non-linearities in the amplifier. As a result, instead of containing a pure amplified CW pilot signal, the output of the amplifier will contain a modulated pilot signal, where the modulation of that pilot signal results from cross-modulation of the input signal on the pilot signal.

10. Fig. 12 in the present application graphically represents both intermodulation distortion and cross-modulation distortion. In the example of Fig. 12, the inputs to a non-linear amplifier are the two RF input signals represented on the left side of Fig. 12 and an injected CW pilot signal on the right side of Fig. 12. As shown in Fig. 12, IMD includes sums and differences of the two RF input signals. In particular, Fig. 12 shows the third-,

fifth-, and seventh-order IMD signals on either side of the two RF input signals.

11. Fig. 12 also shows the third-, fifth-, and seventh-order cross-modulation signals on either side of the CW pilot signal. The two RF input signals on the left side of Fig. 12 can be equivalently represented as a single modulated RF input signal. The cross-modulation signals shown in Fig. 12 result from the transfer of modulation from that single modulated RF input signal to the pilot signal due to non-linearities in the amplifier.

12. Thus, intermodulation distortion and cross-modulation distortion are very different from one another. While intermodulation distortion corresponds to frequencies equal to sums and differences of integer multiples of the input frequency components, cross-modulation of an input signal on a pilot signal corresponds to the transfer of modulation of the input signal onto the pilot signal.

13. Advantages of linearizing based on cross-modulation of the input signal on the pilot signal include (1) the ability to use a single pilot tone and (2) the ability to design the control system based on the known frequency of that single pilot tone.

14. In a typical amplifier system, the frequency components of the received RF input signal might not be known and/or they may change over time. Since IMD is a function of the sums and differences of integer multiples of input frequency components, the exact frequencies of the IMD products might also not be known and/or they may also change over time. To avoid this uncertainty, prior-art solutions, such as those described in Nojima rely on the insertion of two known pilot signals so that IMD products based solely on those two pilot signals will be known and the control system can be designed based on those known IMD product frequencies.

15. By controlling the linearization of an amplifier system based on cross-modulation of the input signal on the pilot signal, the present invention can be (but does not necessarily have to be) implemented using a single CW pilot tone. Since cross-modulation of the input signal on the pilot signal corresponds to modulation of the amplified pilot tone, the

control system can be designed based on the known frequency of that single pilot tone. The modulation of the amplified pilot tone may vary for different RF input signals, but the frequency of the amplified pilot tone will not. As a result, the present invention can be implemented in an amplifier system having a single pilot tone, wherein the control system is designed based on the known frequency of that single pilot tone.

16. Nojima teaches an amplifier system having two pilot signals where the amplifier system is linearized based on IMD products of those two pilot signals. While it may be true that there is "inherent cross-modulation of the input signal on the pilot" in Nojima's amplifier system, that does not mean that Nojima's system controls linearization based on detection of cross-modulation distortion. There is no discussion of cross-modulation at all in Nojima, let alone a discussion of the use of cross-modulation distortion to control the linearization of an amplifier.

17. Ciesielka teaches a technique for tuning a circuit having an amplifier. According to this technique, instead of applying an input signal from information source 10, pilot tone source 15 sequentially applies individual pilot signals having different frequencies to the circuit to adjust the frequency-dependent gain characteristic of equalizer 30. See, e.g., column 3, lines 29-57. Ciesielka's Fig. 1 clearly shows a two-pole switch having two switch positions: a first switch position in which only a pilot signal from pilot tone source 15 is applied to the circuit and a second switch position in which only a signal from information source 10 is applied to the circuit. There is no switch position taught in Ciesielka in which signals from both pilot tone source 15 and information source 10 are simultaneously applied to the circuit. In fact, doing so would destroy the functionality of Ciesielka's tuning technique.

18. Since signals from pilot tone source 15 and information source 10 are never simultaneously applied to Ciesielka's circuit, Ciesielka's circuit cannot possibly be interpreted as being controlled based on cross-modulation distortion of an input signal on a pilot signal, because such cross-modulation distortion never even exists in Ciesielka. Ciesielka contains no discussion of cross-modulation distortion or even intermodulation

distortion. This makes sense since only one signal at a time is ever applied to Ciesielka's circuit and such distortion therefore does not even exist.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Dec 6, 2007
Date

George P. Vella-Coleiro